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EVALUATION OF SURFACE TREATMENT TEST PITS

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EVALUATION OF SURFACE TREATMENT TEST PITS

by

D.R. Murray* and H. Willett**

ABSTRACT

A study to investigate the impact of surface treatment on tailing seepage water was initiated in 1975. After 5-years of operation the results were published in 1980. The report highlighted several irregularities, one of which was the reduction in seepage flow. This investigation examined the water collection system to determine the cause of seepage reduction. Tailings and chemical precipitation plugs were discovered in drain pipes and removed. Modifications were made to permit future maintenance of the free drainage.

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INTRODUCTION

A study to investigate the impact of various surface treatments on the quality and quantity of seepage water was jointly undertaken by Rio Algom Ltd. and CANMET. Between 1975 and 1979 six lysimeter pits were constructed according to the design on Fig. 1. Five of them had drainage tile placed at their base while the 6th was excavated 1.5 m deeper with no drainage tile. Surface covers were applied and maintained. During the 5-year period flow rates and water samples were taken for quality determinations. The results of this study were published in 1980 (1). There were several discrepancies in the data that did not permit a clear conclusion.

In 1982 it was decided to investigate the integrity of the under-drainage lines and tile to enable more light to be shed on the previous study results. The pits had become flooded, indicating a blockage in draining. This study was to determine the type of blockage and correct the situation if possible to ensure the integrity of the pit structure for future studies.

PROCEDURE

The plan layout of the lysimeter pits is shown in Fig. 2. The pits are numbered for easy reference. The drainage lines of pits 2 to 6 were exposed approximately 3-4 m from the surface edge of the pit by excavating to a depth of 1.5 m using a backhoe and shovels. Once the line was exposed, it was cut with a hacksaw for examination and permitted to drain freely. Samples were taken of sludges and water from some lines.

A 2.5 cm water line was used to clear the line between the cut and the sample shed as well as back flushing the line and tile under the pit. Once cleared of blockage, each pit was permitted to drain freely.

A 2 cm plywood manhole, 1 x 1 x 1.5 m was constructed and placed

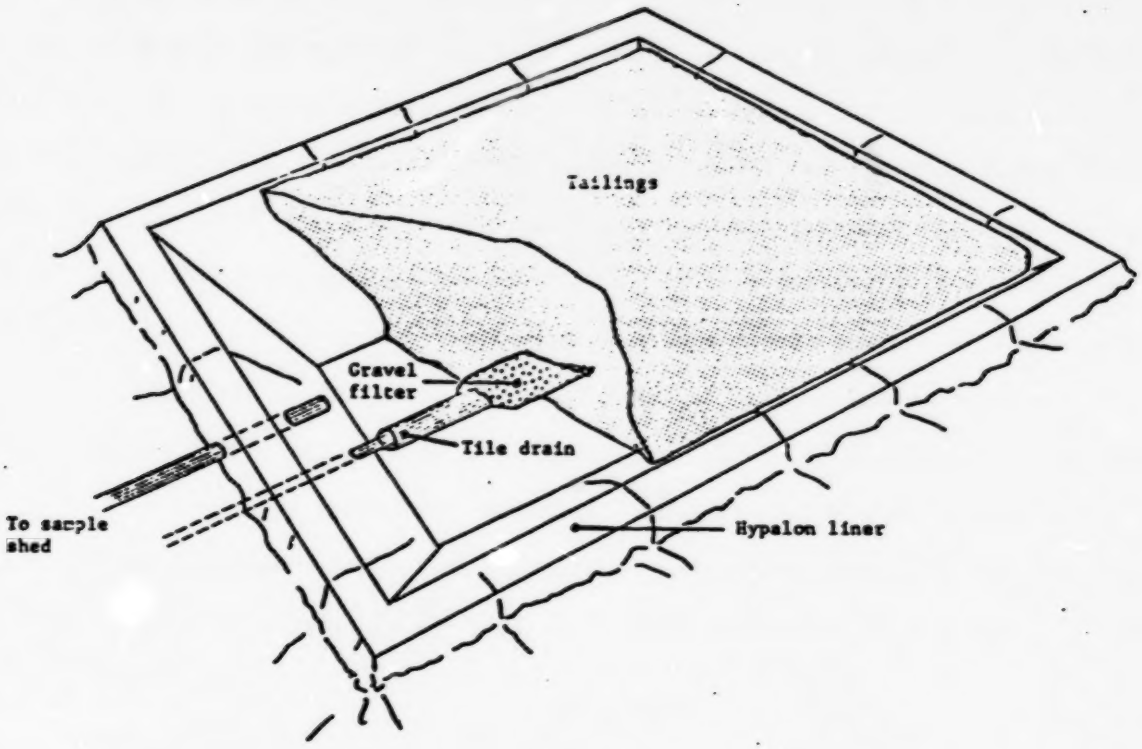

Fig. 1 - Pit construction.

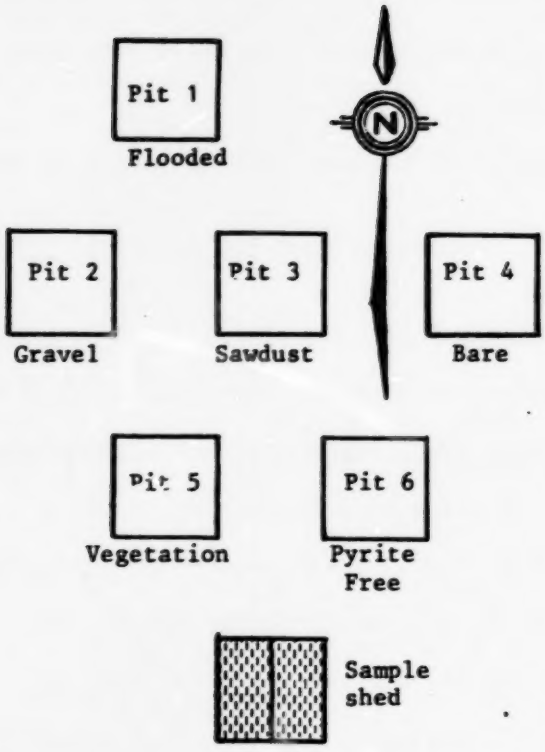

Fig. 3 - Pit layout.

over the cut part of the line. Sand and gravel were backfilled outside the box. A section of pipe was removed and the two ends joined with a removable section of pipe. Stainless steel jackets with a neoprene sleeve provided suitable couplings, making it possible to easily remove the pipe section for future servicing and not permit any internal obstruction to the water flow. A lid was securely placed on the top of each box. The drainage lines were then left free draining while water flow rates were made and grab water samples were taken for analysis.

The arrangement of the new drainage system is shown in Fig. 3.

OBSERVATIONS AND RESULTS

Pit # 5 (vegetated pit) was the first to be examined. The drainage line contained a variety of sludges. Approximately 6 m from the tile line in the drainage line were large clumps of material obviously the products of chemical reaction. Flushing back to the tile provided 2 sludge samples taken until the drainage was clear. These sludges were analyzed and the results are shown in Tables 1 and 2. On the remaining pits it was found that each was plugged between the cut and the sample shed to varying degrees. The drain from pit # 6 (pyrite free) was plugged with a black sulphurous smelling sludge. Analysis of this sludge showed that the material was not pyrite and may have been residual flotation agent. Pit # 6 also showed a piping failure of the tile line letting solid tailings move into the drainage line. At this time no effort was made to excavate the pit to repair the tile line. The sawdust pit contained the greatest amount of sludge and clearing had to be done for the full length of the drainage line. In each case water freely flowed from the cut lines. All lines were freed by the first week of October and solution samples were not taken for 3-weeks to allow for the bulk of the contained water to drain from the pit. Records of flows and spot analyses are shown in Table 3.

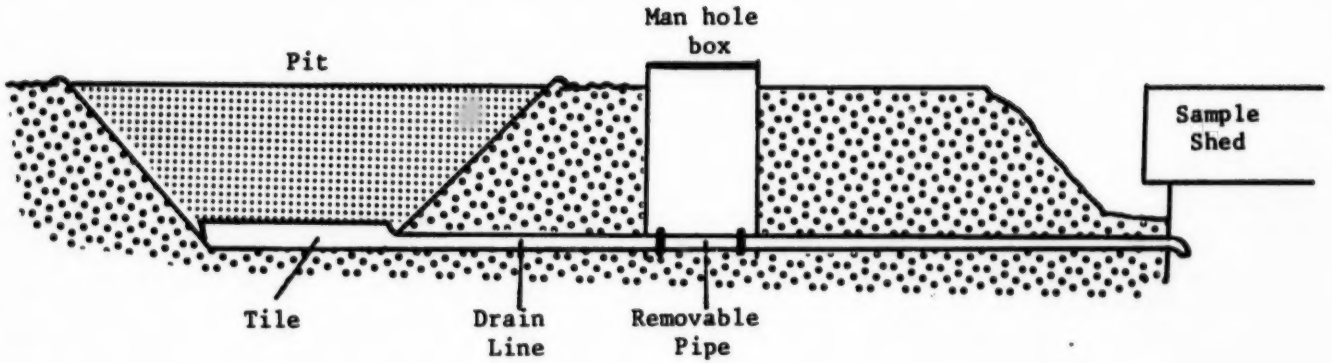

Fig. 3 - Modified pit drainage system for easy servicing.

Table 1 - Sludge samples from # 5 tailings pit

	% Fe^T*	% Ca	% Mg	% K	% Al	% SiO_2	% SO_4	% NO_3	% NH_4	% Na	% L.O.I**	Pc/gm Ra-226
A	26.99	1.92	.086	0.24	4.96	5.72	16.20	0.13	0.014	0.41	31.8	93
B	10.92	1.15	.028	.053	8.29	27.38	12.98	0.09	0.008	0.047	27.5	169
C	2.97	2.78	.063	1.66	3.92	64.42	7.66	0.02	0.006	0.051	6.9	510

*T Total
**L.O.I. Loss on ignition.

Sample Description

A Sample taken between cut and sample shed.
B Sample taken between cut and pit tile.
C Sample taken in pit tile line.

Table 2 - Solution sample from # 5 tailings pit

	g/L Fe^T	g/L Fe^{++}	ppm Ca	ppm Mg	ppm K	ppm Al	g/L SO_4	ppm NO_3 as N	ppm NH_4 as N
D	3.94	3.56	405	138	9.2	171	9.61	.39	2.8

	ppm Na	pCi/L Ra226	ppm Co	ppm Ca	ppm Pb	ppm Mn	pH	($CaCO_3$) g/L Acidity	µS Conduct.
D	2	77	5.9	1.6	1.8	15	2.95	6.65	8176

D is solution sample taken following line clearing and drainage.

Table 3 - Flow rate and water quality from test pits

Flow Rate mL/min

Pit	October 21	October 22	November 2
2	600	490	110
3	350	350	240
4	580	475	160
5	310	260	115
6	800	620	130

Water Quality

Pit	SO_4 g/L Oct. 21	SO_4 g/L Nov. 3	pH Oct. 21	pH Nov. 3	Fe^T g/L Oct. 21	Fe^T g/L Nov. 3	Fe^{++} g/L Oct. 21	Fe^{++} g/L Nov. 3	Ra pCi/L Oct. 21	U_3O_8 g/L Oct. 21	U_3O_8 g/L Oct. 22
2	2.95	2.58	4.24	4.49	.872	.725	.750	.714	91	.005	.006
3	4.36	3.77	4.59	4.57	1.47	1.28	1.41	1.27	98	.006	.008
4	13.2	12.2	2.67	2.73	4.48	4.53	4.10	4.31	75	.034	.037
5	10.9	10.3	2.54	2.50	3.29	3.40	2.83	3.00	74	.030	.025
6	1.64	1.72	5.85	6.58	.320	.356	.302	.339	167	.002	.003

DISCUSSION

From this investigation, the reason for the low flow observed in the previous investigation (1), and the flooded pits was in fact blocked drainage pipes. From the analysis done on Pit 5, and shown in Table 1 it became apparent that both solids and chemical precipitates caused the blockage. Looking at the SiO_2, SO_4, and Fe values it is seen that the amount of silica or solid material increases as samples progressed towards the tile. The sulphate and iron indicate the products of pyrite oxidation formed in the bulk of the material blocking the pipe line, but not in the tile line.

From this we find that the tile drainage system in the original construction was still intact and functioning. The problem has been with the collection of precipitates and solids in the lines between the pits and the sample shed where oxygen has been able to be present. The sludge closest to the tile, very much resembles the characteristics of the original tailings deposition and as such would have been initial slimes washed through the coarse filter.

With the access boxes now installed the lines can be regularly checked to see if there is any future build-up of material and flush it out as required.

The flow rate reported in Table 3 shows the hydraulic response of the pits. The chemical analysis also indicates consistency in the quality of the effluent water from one sampling to the next.

Although a detailed chemical comparison is not possible it appears that the vegetative pit is responding similarly to the bare tailings pit at this point.

RECOMMENDATIONS

The pits as originally constructed have maintained their integrity except for the pyrite free pit, # 6. The problem of line blockage on route to the sample shed has been corrected and facilities are in place to permit easy access for future checking and clearing of these lines.

These pits provide an excellent opportunity for continued study of the environmental problems and treatment of uranium mill tailings.

REFERENCE

1. Murray, D.R. and Okuhara, D., "Effect of surface treatment of tailings on effluent quality"; Reclamation Review, vol 3, no. 3, pp 169-177; 1980.